

Review of Airborne Electromagnetic Survey Methods Applied to Uranium Exploration and Resource Assessment, with Emphasis on Unconformity, Breccia Pipe and Sandstone-hosted Deposits

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Over the last decade the U.S. Geological Survey (USGS) has applied several types of airborne electromagnetic (AEM) methods to map subsurface hydrogeologic frameworks in groundwater resource studies. Many of the same AEM methods have been successfully applied to uranium exploration. This presentation reviews the application of AEM methods in the context of subsurface geologic and hydrologic mapping as applied to uranium deposits. Significant advances have been made over the last decade in AEM instrumentation, data processing, and interpretation that have been used to better map deep and subtle contrasts in electrical properties due to geologic contrasts. These improvements have enhanced applications for three dimensional hydrologic and geologic mapping and modeling. Collectively recent applications have shown that AEM can contribute significant new information even in areas that have been intensively drilled or mapped.

The International Atomic Energy Agency (IAEA) lists thirteen different uranium deposit types. Some of the largest deposits are unconformity types in the Athabasca Basin of Canada which are associated with graphitic metasediments and structures. AEM has been used to identify drill targets including graphitic schist (low resistivity), altered zones (low resistivity anomalies above the target), structure (electrical property" contrasts), and the paleo-topography of the unconformities. New AEM technology has extended the depth of exploration for unconformity type deposits.

Sandstone-hosted uranium deposits are considered a large potential global resource. Interestingly, in contrast to unconformity type deposits, non radiometric geophysical methods, in particular AEM has not been widely used in exploration for sandstone hosted deposits; this is mostly because drilling costs are lower and interpretation is more complex than "simple anomaly hunting". Recent refinements of AEM methods in quantitative groundwater and geologic mapping programs demonstrate their utility in mapping subsurface sedimentary architecture. AEM can be used to recognize and map buried paleochannels that could be potential ore hosts in sandstone uranium environments. AEM surveys could also be used to map variability in

confining layers (shales), which are critical in design of insitu leach operations and in evaluation of abandonment measures.

Another application of AEM methods is in exploration for breccia pipe hosted uranium deposits in the Colorado Plateau region. Interpretative geophysical work on AEM data from these exploration programs illustrates that proper calibration of AEM can be an important factor in modeling and interpretation of subsurface targets.